NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

April 26, 2010

MATERIALS LABORATORY FACTUAL REPORT Report No. 10-122

A. ACCIDENT

Place : Waxahachie, Texas
Date : January 23, 2010
Vehicle : Tecnam P2002
NTSB No. : CEN10FA107
Investigator : Tom Latson

B. COMPONENTS EXAMINED

1. Forward stabilator control tube with fractured forward rod end
2. Bottom piece of fuselage tail section including stabilator control tube pass through plate mounting braces
3. Mechanic's work light
4. Control mixing unit
5. Aft stabilator control tube with pass-through plate.

C. DETAILS OF THE EXAMINATION

Figure 1 shows a view looking aft of the inside of the fuselage tail section. As indicated in figure 1, a mechanic's work light is observed in the general proximity of the stabilator control tube and the pass thru plate. The as-received components from the aircraft wreckage are shown in Figure 2. The sketch in Figure 3 depicts the general location of the submitted pieces on the aircraft.

Detailed images of the forward stabilator rod in Figure 2a are shown in Figure 4. The fracture features and thread damage indicate that the rod end fractured in ductile overstress due to downward cantilever bending.

The forward control mixing unit is shown in Figure 5. Three areas of bending overstress fracture are indicated in the figure. A bend in a linkage is also indicated.

Photographs of the aft stabilator control tube assembled with the pass-thru plate are shown in Figure 6. As indicated in Figure 6a, the stabilator control tube piece is fractured at the forward end due to upward bending overstress, and is bent and buckled in two places along its length. Figures 6a and b indicate that the pass through plate is bent in the forward direction. The edge of the hole in the pass through plate is deformed in a manner

consistent with forward sliding contact with the stabilator control tube. The rubber grommet, which was once installed in the pass-thru plate hole (based on paint spatter and other fiducial marks), has a radial through-thickness cut in the wall. The radial cut in the grommet is consistent with the application of lateral force applied between the stabilator control tube and the pass-thru plate.

As indicated in Figure 6a and b, the surface of the stabilator has a thin, greasy residue in the region identified in Figure 6b. In this same region, the surface of the stabilator control tube exhibits features consistent with scoring and galling. Excrescence[1] features due to galling are consistent with forward sliding contact between the stabilator control tube and the edge of the pass-thru plate hole.

As indicated in Figure 1 and 3, a mechanic's work light was discovered within the tail section of the fuselage after the accident. Figure 7 shows views of the primary surfaces of the work light. There are no manufacturer marks on the exterior surfaces of the work light or under the rubber handle grip, which readily slides off the handle. The initials *WBS* are written on the side of the work light as shown in Figure 7a and on the back side of the handle under the rubber handle grip. A wear scar was observed on the side of the light as indicated in Figure 7d.

Figure 8a is closer view of the work light body adjacent to the on-off switch shown in Figure 7b. Between the switch and the rubber handle grip a score mark is present in the plastic work light body. This score mark is consistent with the body of the work light contacting a sharp edge or burr. Similar score marks are observed on the backside of the work light near the hook as indicated in Figure 7d and Figure 8b. Key feature dimensions of the repetitive diamond pattern on the rubber handle grip are indicated in Figure 7b and Figure 9.

The bottom section of the fuselage tail (see Figures 2b and 5) was removed from the aircraft wreckage for closer examination. A closer view of the bottom piece is shown in Figure 10a. Black marks (referred to as transfer marks in this report) are present in various areas on the inner surface of the bottom piece of fuselage tail as indicated in Figure 10. Under optical microscopic examination, the black transfer marks are consistent with tribotransfer of material from the work light's black rubber handle grip. Figures 11 and 12 are optical microscope images of two regions exhibiting black transfer marks. In Figure 11a, the image is digitally altered to enhance the contrast between the transfer marks and the as-primed surface of the inner fuselage. Features consistent with the repetitive diamond pattern on the mechanic's work light rubber handle grip are present on the inner fuselage surface. Measurement of these specific transfer marks is shown in Figure 11b. A sketch in Figure 12 shows the key dimensions of the diamond features. A table in Figure 13 summarizes the key dimensions of the diamond pattern of the work light handle grip and the black transfer marks on the inner bottom surface of the fuselage. Based on the key

[1] In accordance with ASTM G40, galling is a form of surface damage arising between sliding solids, distinguished by microscopic, usually localized, roughening and creation of protrusions (excrescences), above the original surface. Sliding direction may be ascertained from the excrescence features.

dimensional measurements, it appears that the black transfer marks on the inner bottom surface of the fuselage tail section are consistent with marks made by the work light's rubber handle grip.

Michael K. Budinski
Chief, Materials Laboratory Division

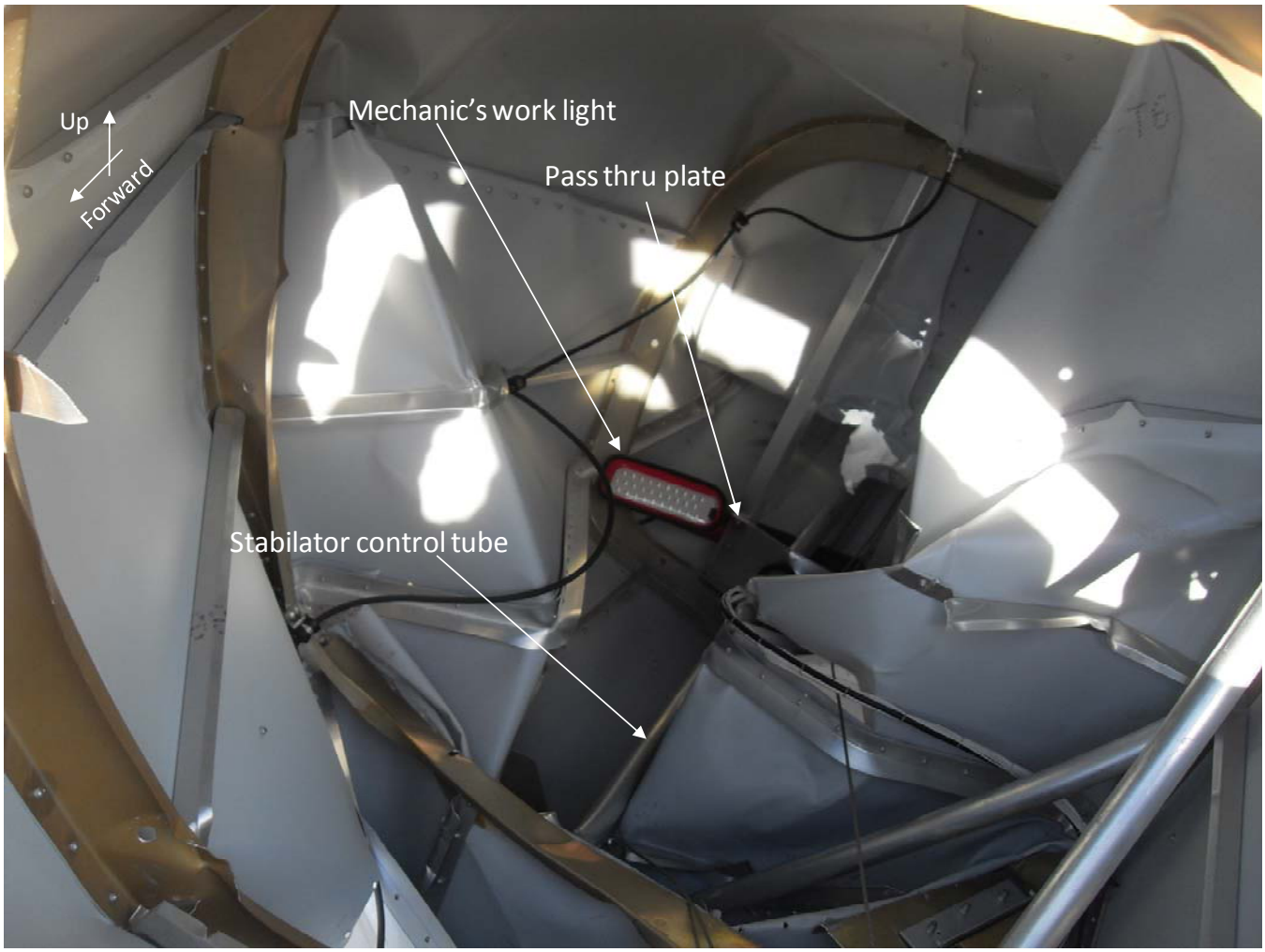


Figure 1 View looking aft of the inside of the aircraft tail section after the accident. Note the presence of a mechanic's work light located near the bulkhead with the stabilator pass thru plate.

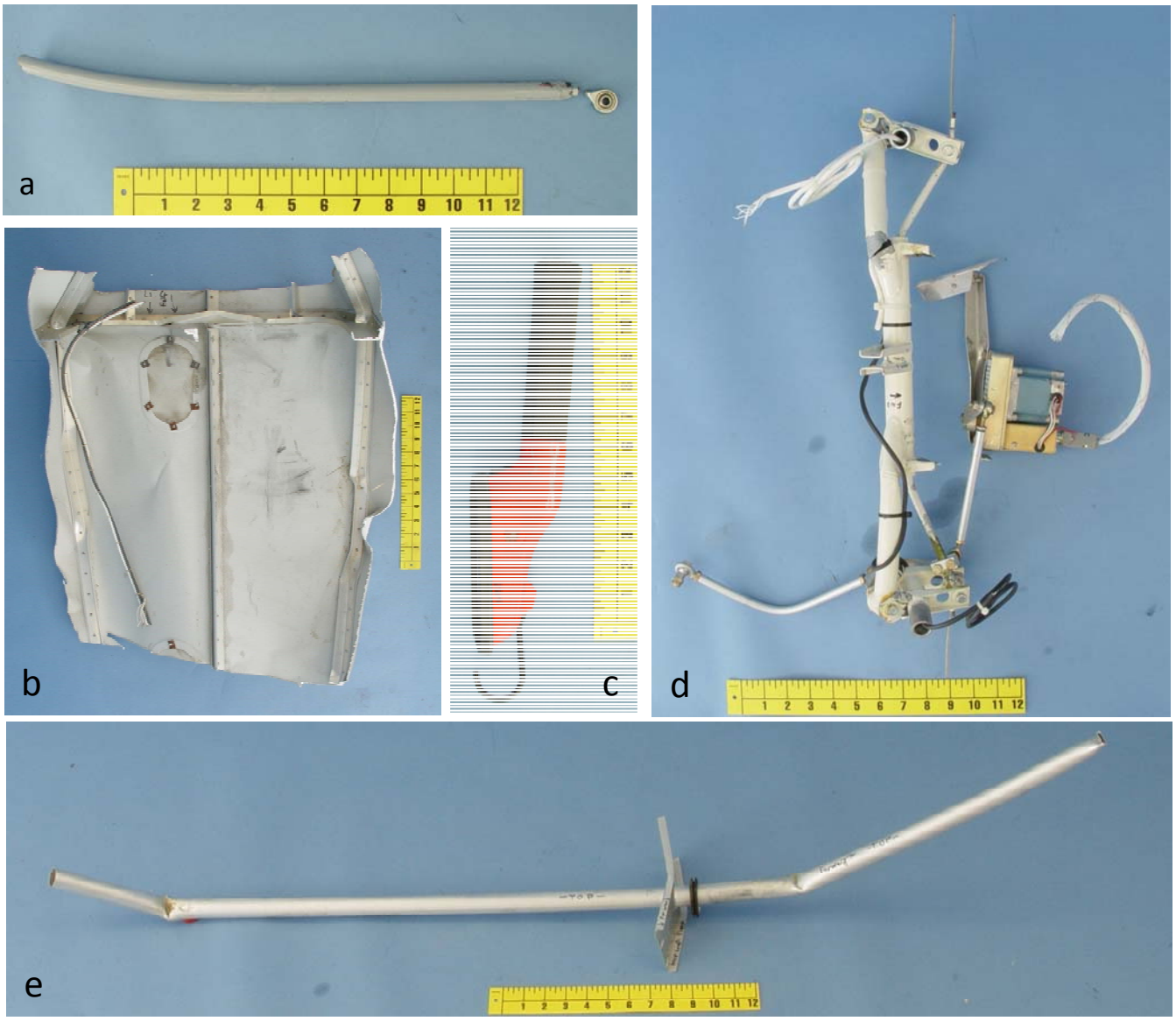


Figure 2 Parts submitted for this examination: a) forward stabilator control tube with fractured forward rod end; b) bottom piece of fuselage tail section including stabilator control tube pass through plate mounting braces; c) mechanic's work light; d) control mixing unit; e) aft stabilator control tube with pass-through plate.

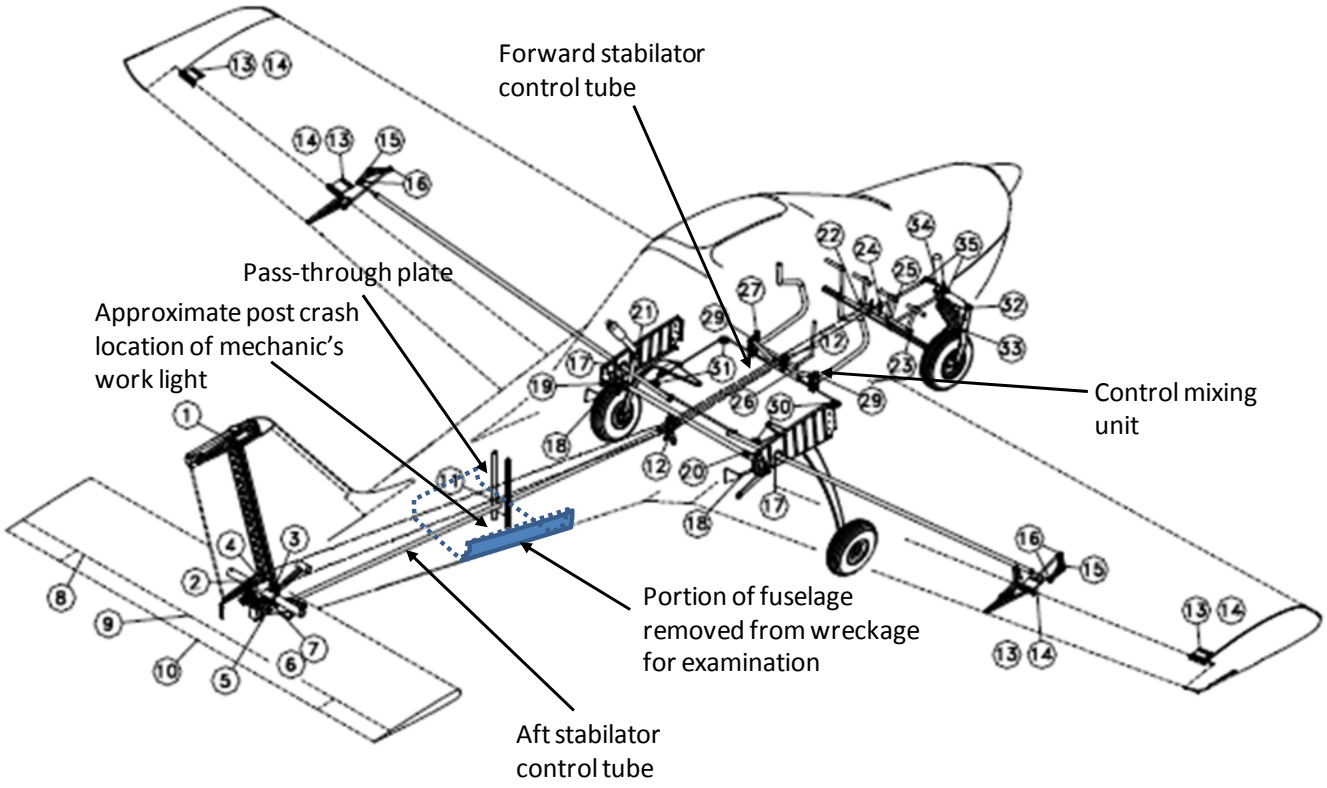


Figure 3 Image of the aircraft showing the relative arrangement of components identified in Figure 2.

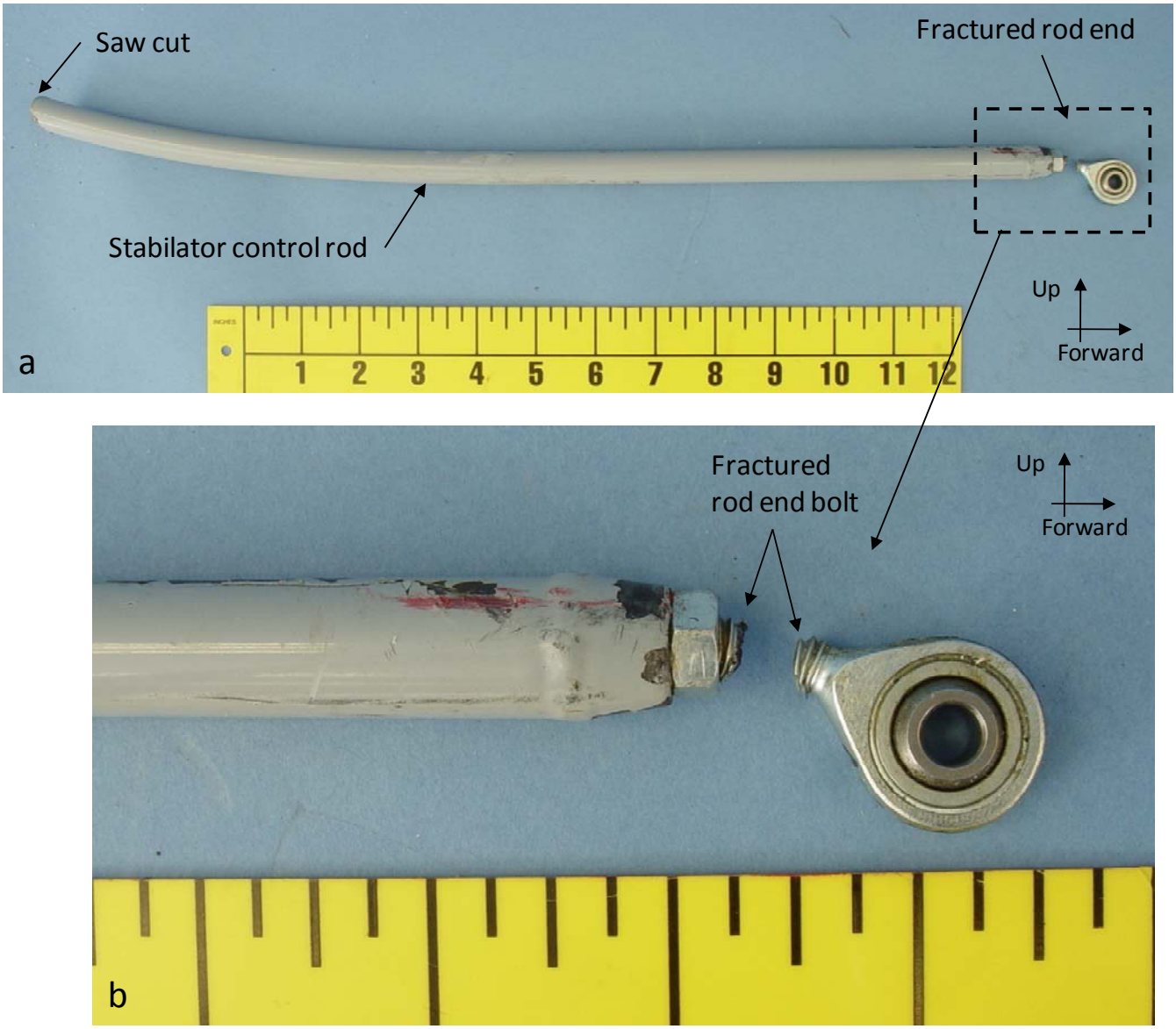


Figure 4 Views of the forward stabilator control rod. a) forward stabilator control rod with fractured rod end. b) close up view of the fractured rod end. The fracture features and thread damage indicate that the rod end fractured in ductile overstress due to downward cantilever bending.

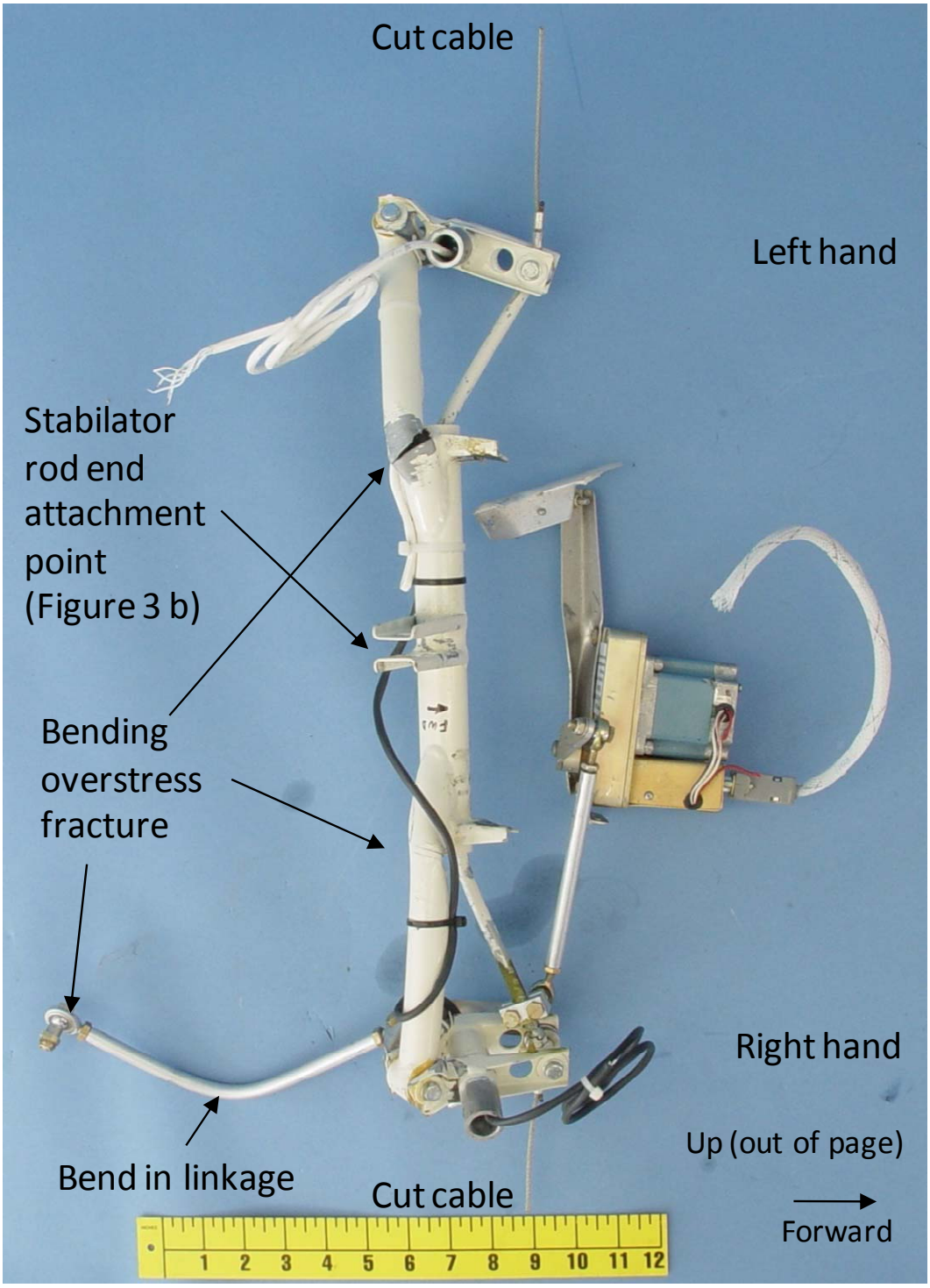
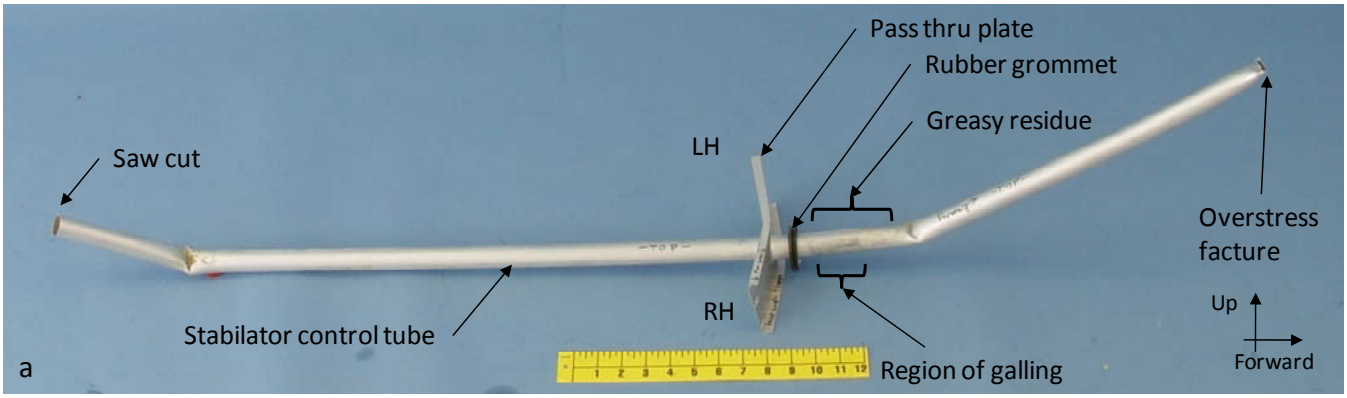


Figure 5 Forward control mixing unit showing areas of bending overstress fracture.



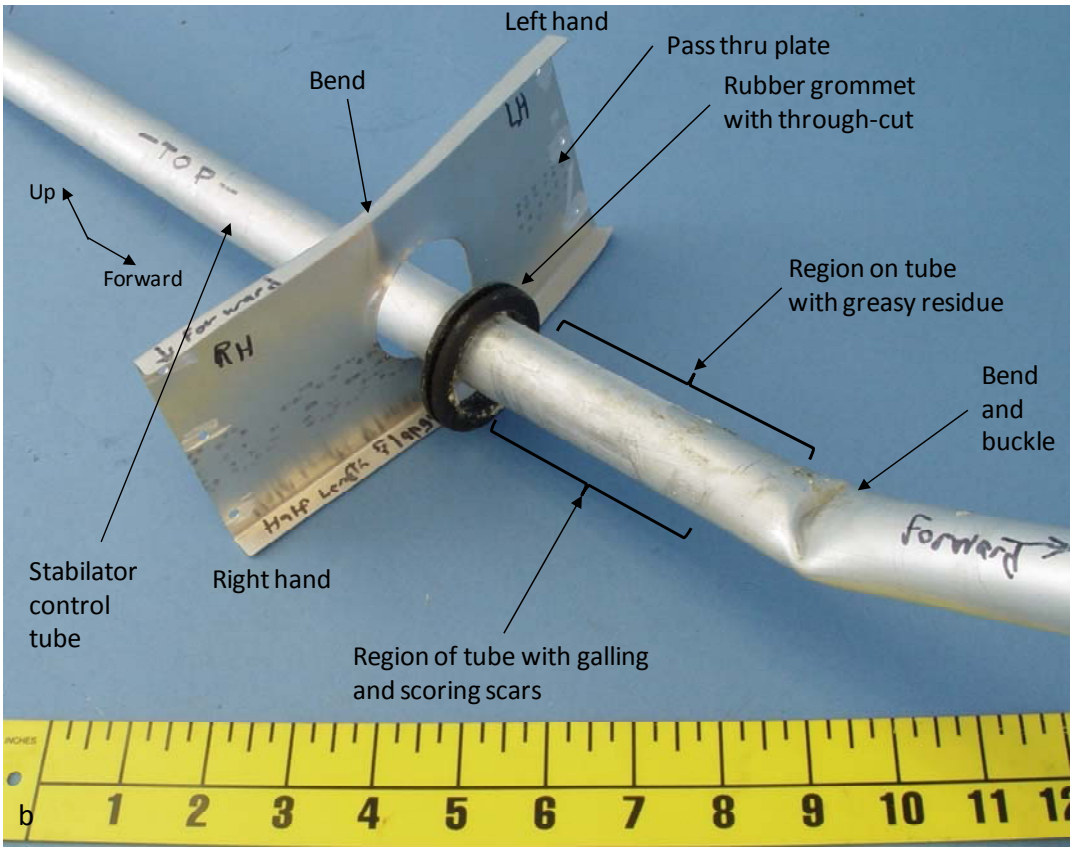


Figure 6 View (a) shows the overall stabilator control tube with key features. View (b) shows close up details of the stabilator control tube in relation to the pass thru plate.

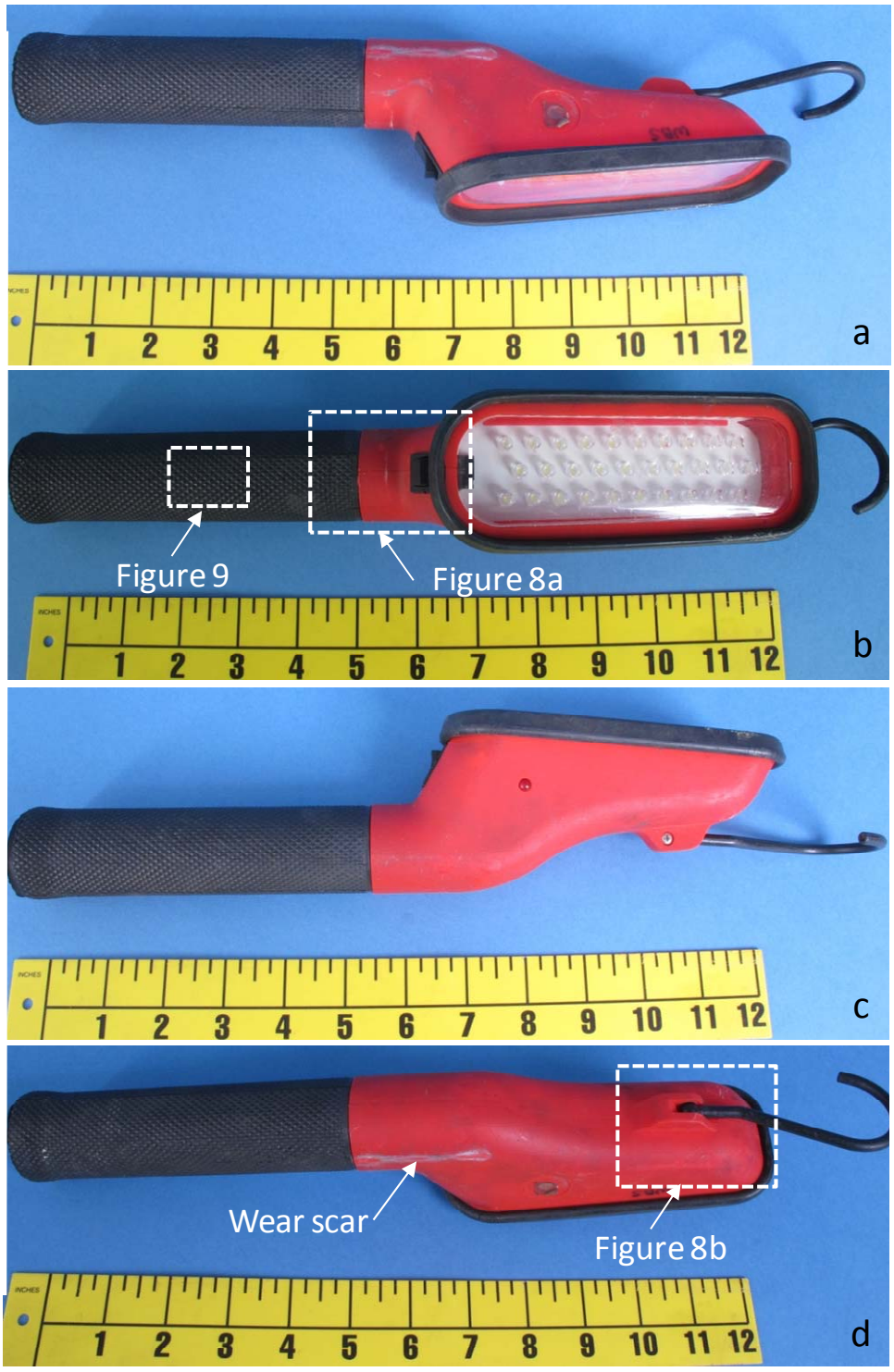


Figure 7 Views showing each side of the work light found in the fuselage tail section after the accident.

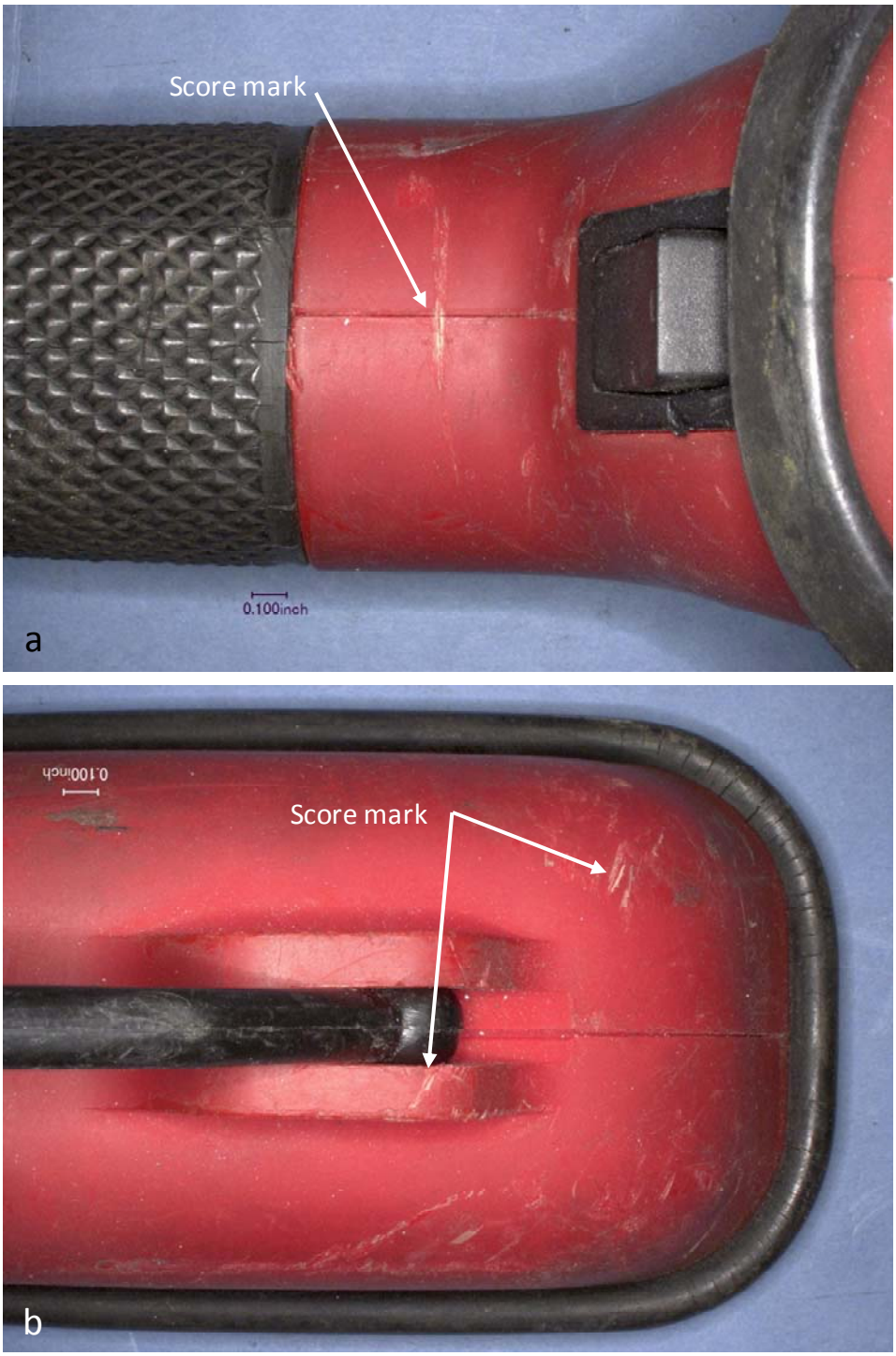


Figure 8 View (a) is a close up of the switch region indicated in Figure 7 b showing a well defined score mark in the plastic housing just under the light switch.

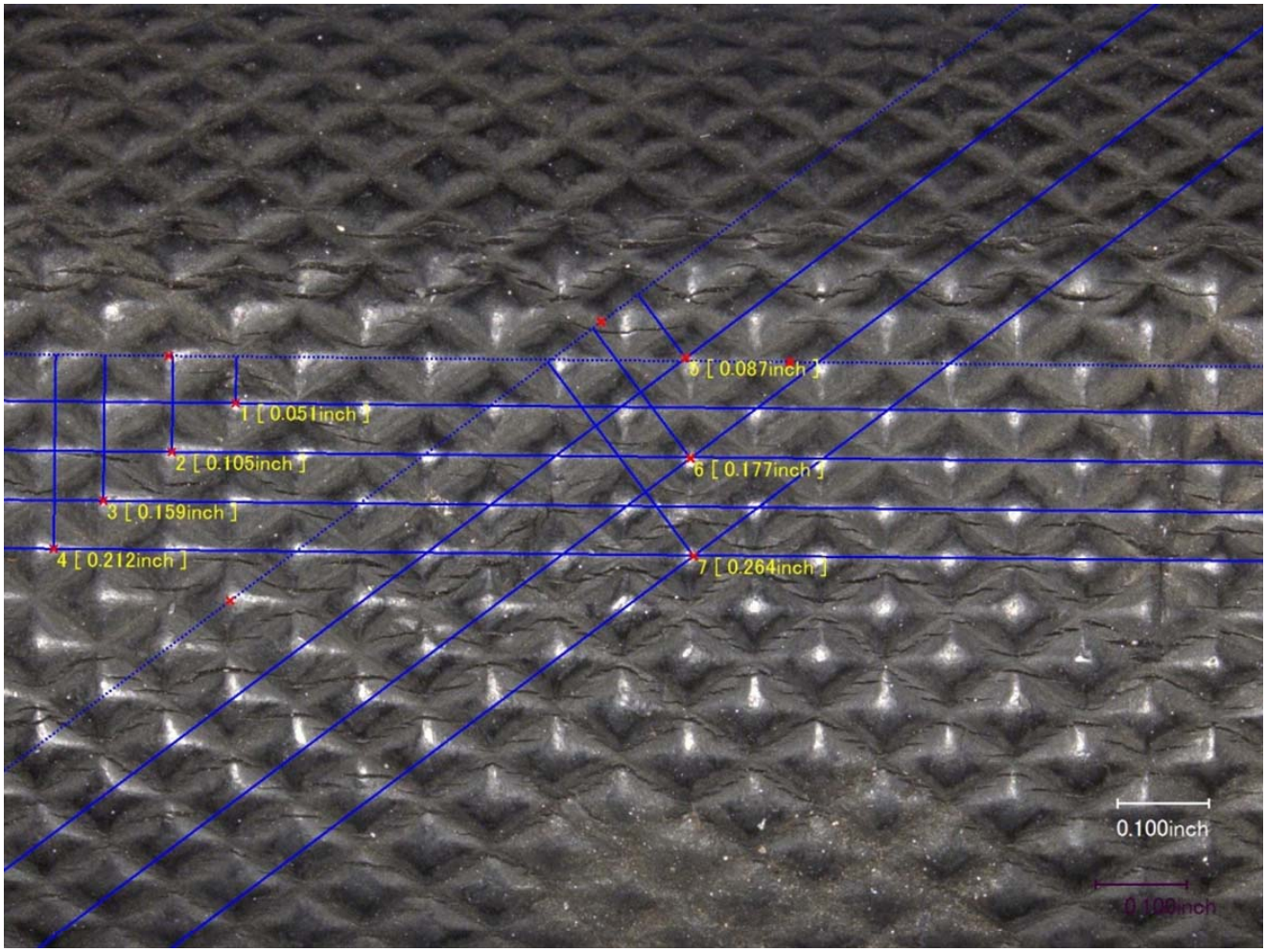


Figure 9 Close up view of the work light handle shown in Figure 7 b depicting key dimensions of the repetitive diamond grip features.

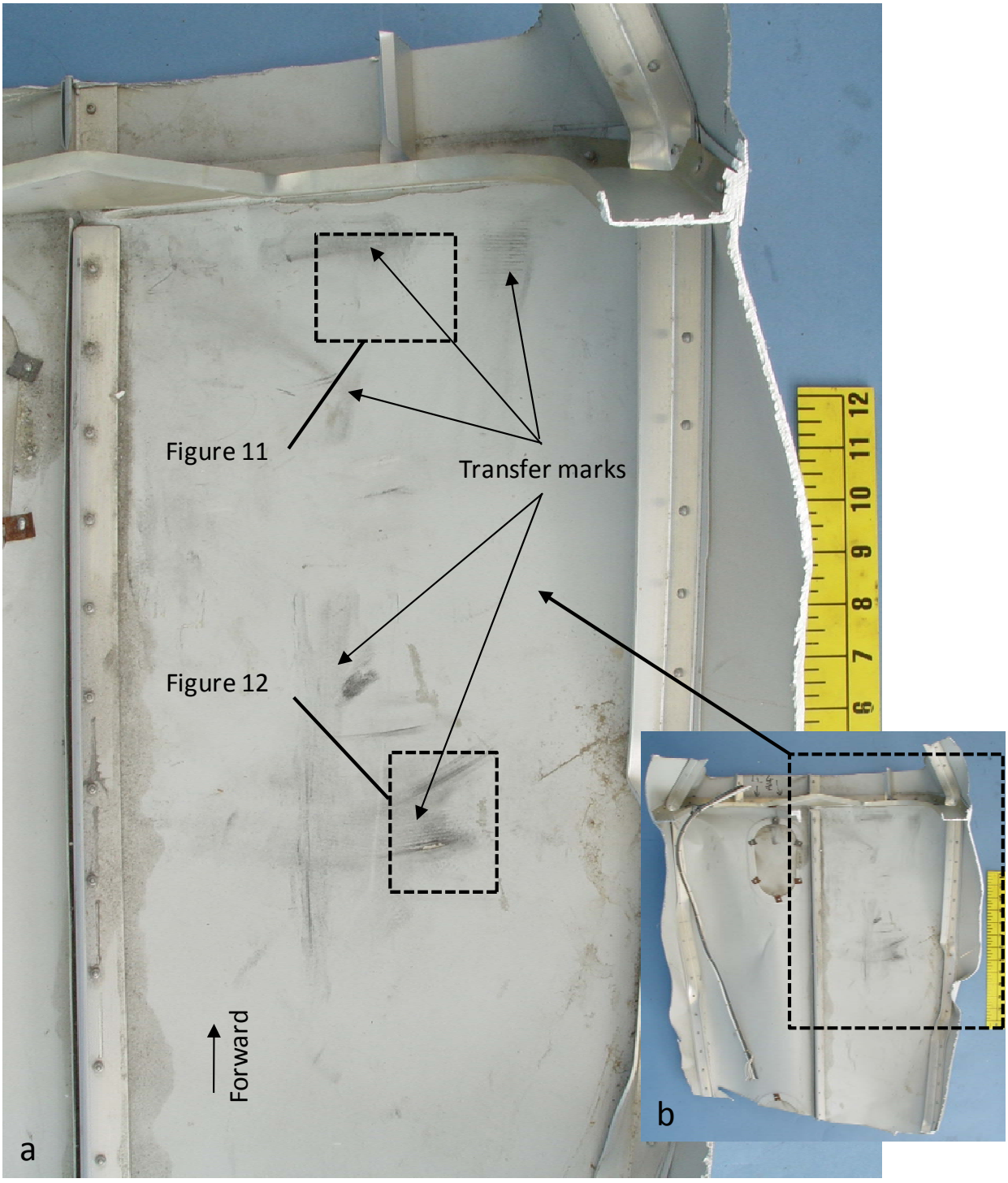


Figure 10 Internal surface of the bottom of the fuselage tail section right and aft of the bulkhead containing the stabilator control tube pass-thru plate. A plurality of black transfer marks are noted on the surface.

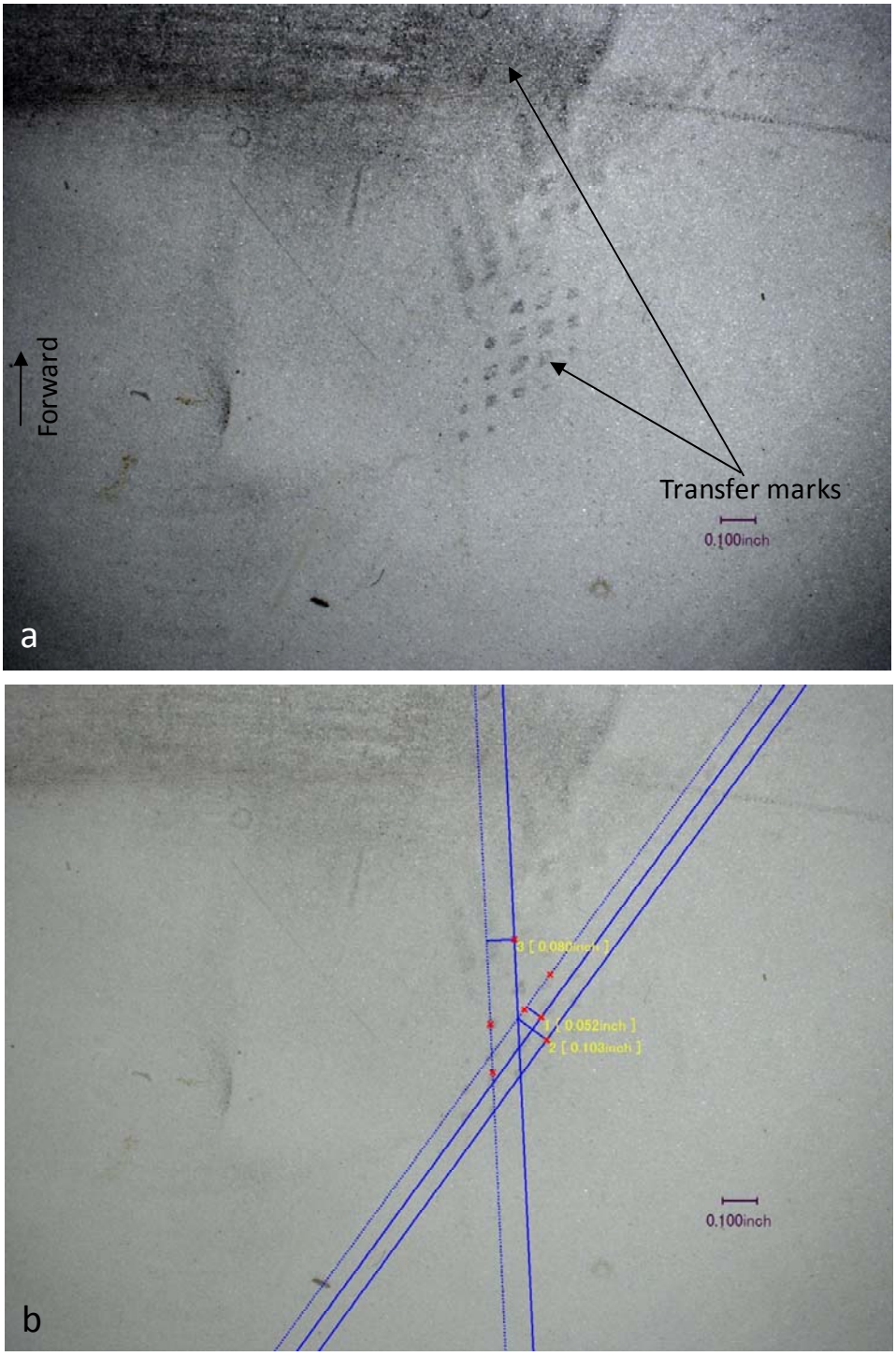


Figure 11 Close up image of the transfer mark indicated in Figure 10. View (a) is digitally enhanced to reveal diamond patterns in the transfer marks. View (b) shows the key dimensions of the diamond patterns in the transfer marks.

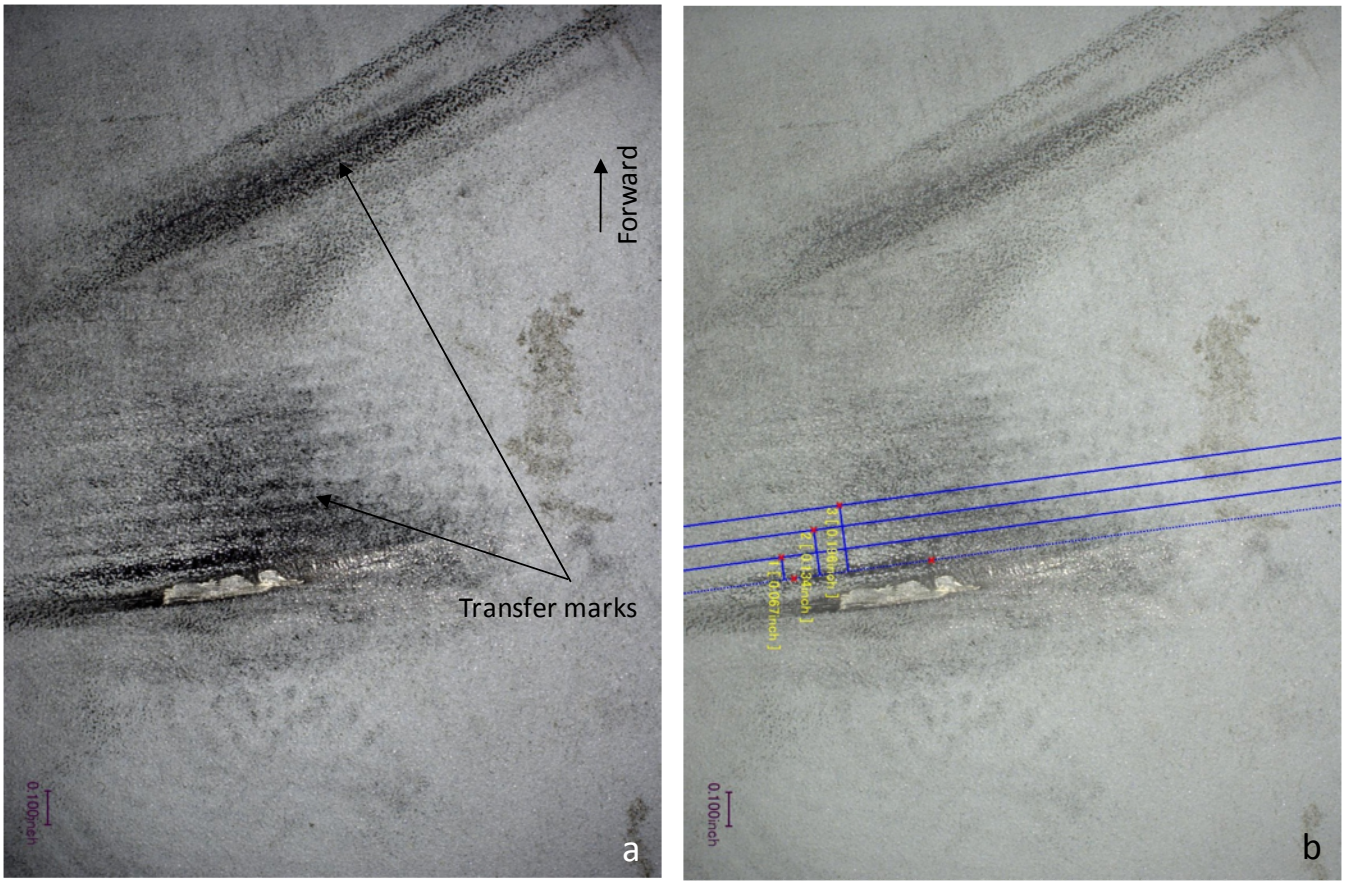
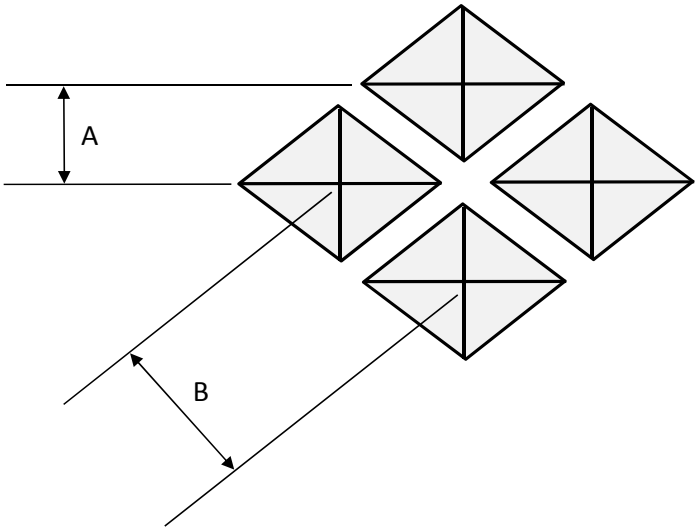


Figure 12 Close up image of the transfer mark indicated in Figure 10. View (a) is digitally enhanced to reveal diamond patterns in the transfer marks. View (b) shows the key dimensions of the diamond patterns in the transfer marks.



	A (inch)	B (inch)
Work light grip pattern (Figure 9)	0.052	0.080
Transfer marks (Figure 11)	0.053	0.088

Figure 13 A sketch of the repetitive diamond pattern on the work light handle and a summary of the key dimensions from the transfer marks in Figure 11 and the work light grip pattern in Figure 9.